



## NASA SBIR 2005 Phase I Solicitation

### X12.07 Advanced Life Support: Water and Waste Processing

Lead Center: JSC

Participating Center(s): ARC, GRC, KSC, MSFC

Regenerative closed-loop life support systems will be essential to enable human planetary exploration as outlined in the Vision for Space Exploration. These future systems must provide additional mass balance closure to further reduce logistics requirements and to promote self-sufficiency. Recovery of useful resources from liquid and solid wastes will be essential. Requirements include safe operability in micro- and partial-gravity, ambient and reduced-pressure environments, high reliability, regeneration and minimal use of expendables, ease of maintenance, and low-system volume, mass and power. Proposals should explicitly describe how the work is expected to improve power, volume, mass, logistics, crew time, safety and/or reliability, giving comparisons to existing state-of-the art technologies. Additional documentation and information can be found at <http://advlifesupport.jsc.nasa.gov>, including the expected composition of solid wastes and wastewater, which can be found within the "Baseline Values and Assumptions Document".

#### Water Reclamation

Efficient, direct treatment of wastewater and product water consisting of urine, brines, wash water, humidity condensate, and or product water derived from *in situ* planetary resources, to produce potable and hygiene water supplies. Technologies that contribute to closing the water loop will be given higher priority. Areas of emphasis include:

- Novel methods of process design and integration to minimize trace contaminant carryover from the cabin atmosphere leading to reduced logistics needs;
- Physicochemical methods for primary wastewater treatment to reduce total organic carbon from 1000 mg/L to less than 50 mg/L and/or total dissolved solids from 1000 mg/L to less than 100 mg/L;
- Post-treatment methods to reduce total organic carbon from 100 mg/L to less than 0.25 mg/L in the presence of 50 mg/L bicarbonate ions, 25 mg/L ammonium ions and 25 ppm other inorganic ions;
- Methods for the phase separation of solids, gases, and liquids in a microgravity environment that are insensitive to fouling mechanisms;
- Methods for the recovery of water from brine solutions;
- Methods to eliminate or manage solids precipitation in wastewater lines;
- Disinfection technologies for potable water storage and point-of-use. Residual disinfectants for potable water that is compatible with processing systems including biological treatment; and

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- Techniques to minimize or eliminate biofilm and microbial contamination from potable water and water treatment systems, including components such as pipes, tanks, flow meters, check valves, regulators, etc.

### **Solid Waste Management**

Wastes (trash, food packaging, feces, biomass, paper, tape, filters, water brines, clothing, hygiene wipes, etc.) must be managed to protect crew health, safety, and quality of life, to avoid harmful contamination of planetary surfaces (Moon, Earth, and Mars), and to recover useful resources. Treatment methods can include both oxidative and non-oxidative approaches. Areas of emphasis include:

- Volume reduction of wet and dry solid wastes;
- Small and compact fecal collection and/or treatment systems;
- Water recovery from wet wastes (including human fecal wastes, food packaging, brines, etc.);
- Stabilization, sterilization, and/or microbial control technologies to minimize or eliminate biological hazards (to the crew, to Mars, to Earth) associated with waste;
- Mineralization of wastes (especially fecal) to ash and simple gaseous compounds (e.g. CO<sub>2</sub>, CH<sub>4</sub>);
- Containment of solid wastes onboard the spacecraft that incorporates odor abatement technology;
- Containment devices or systems, with low volume and mass, that can maintain isolation of disposed waste on planetary surfaces (such as Mars); and
- Microgravity-compatible technologies for the containment and jettison of solid wastes in space.

### **Component Technologies**

Energy-efficient, low-mass, low-noise, low-vibration or vibration isolating, fail-safe, and reliable components for handling fluids, slurries, biomass, particulates, and solids applicable to spacecraft wastewater treatment and solid waste management, including particle size reduction technologies (0.2 cm to 100 microns), actuators, pumps, conveyors, tubing, ducts, bins, fittings, tanks, couplings, quick disconnects, and valves that operate under varied levels of gravity, pressure, and vacuum.